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BONING CARCASS BEEF ON THE RAIL

A Feasibility Study

Agricultural Research Service
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Prepared by

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in cooperation with

Oklahoma Agricultural Experiment Station

PREFACE

This report is based on research that is part of a broader project to improve methods, equipment, and facilities for the off-farm slaughtering of livestock and for the commercial handling, conditioning, storing, processing, and packaging of meat and meat products.

Boning carcass beef on the rail has never been done in the United States on a commercial basis nor, so far as can be determined, has any experimental work been done to ascertain its feasibility. On-the-rail boning has been used with reported success in Australia and South America. The work reported here was an experiment conducted under controlled conditions to determine whether on-the-rail boning of beef carcasses was feasible and, if feasible, to develop a logical and efficient procedure for this approach to beef boning operations. Further, it was the intent of this research to use the data obtained under these controlled conditions to prepare, through synthesis, a possible layout for an on-the-rail boning line. While data on labor required at each work station have been derived from the controlled experimental work, these data are synthetic and are indicative only of how the system should work--they should not be used as a basis for comparing this boning procedure with conventional methods.

The work was conducted under the general supervision of Tarvin F. Webb, Investigations Leader, Transportation and Facilities Research Division, Agricultural Research Service, U.S. Department of Agriculture, and James A. Whatley, Director, Oklahoma Agricultural Experiment Station.

Robert J. Keller, Head, Facilities Group, Facilities, Equipment and Foreign Programs Branch, Technical Services Division, Consumer and Marketing Service, USDA, and his staff made suggestions on technical problems related to the design of an on-the-rail boning line.

The authors wish to acknowledge the cooperation of the George A. Hormel and Company, Austin, Minn., and to express their appreciation to Tom Prewitt, Manager of the Hormel plant at Miami, Okla., who set aside cooler space for the on-the-rail boning work and provided the carcass beef, the skilled boning workers, and part of the equipment needed for this research.

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BONING CARCASS BEEF ON THE RAIL

A Feasibility Study

By Clayton F. Brasington, Jr., and Donald R. Hammons, industrial engineers,
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Many factors should be carefully considered in the selection of a beef carcass boning system. Initial cost and maintenance along with space required and crew size are items that require a great deal of thought. In recent years numerous boning line operators have replaced their conventional boning tables with the only other system available, the much more expensive multiple work station boning table equipped with a belt or slat conveyor. The conveyorized table eliminates the manual transport of heavy bone-in cuts between the breaking saw and work stations and permits an increase in the number of carcasses boned per hour in about the same floor space. Now that an on-the-rail system has been used successfully in other countries to bone both carcass sides and quarters, the operator considering a change should compare all three systems.

Boning carcass beef while it is suspended from an overhead rail has been practiced successfully for several years by Australian and South American packers. Recently, a meat packer in Ireland installed an on-the-rail boning line similar to those found in Australia. In 1966 a national meat magazine 1/ published an article on the Australian procedure. However, there is no published information to indicate that any major firm in this country has conducted a feasibility study of this approach to removing meat cuts from carcass bones.

This research was undertaken in cooperation with George A. Hormel and Company to provide the meat industry with needed guidelines for evaluating on-the-rail boning and for installing this type of line. The study included: (1) Developing an on-the-rail boning procedure that would produce meat cuts similar to those obtained using conventional methods; (2) training a worker until he became proficient in boning on the rail and making detailed time studies of the work to establish labor requirements; (3) conducting yield tests on opposite carcass sides to compare the quality and weight of various meat cuts boned on the rail and boned on conventional tables; (4) measuring various weight carcasses and grouping them in weight classes to determine work station requirements and equipment needs; and (5) preparing a layout for an on-the-rail boning line to illustrate the design criteria developed during the research studies.

BONING PROCEDURE

Our objective in developing an on-the-rail boning procedure was to find the most efficient way to do the boning work and, at the same time, produce meat cuts of a quality equal to or better than those obtained using conventional

1/ Boning Beef on Power Rails Grows in Importance in Australia, The National Provisioner, 154 (16): 24-26. 1966.

boning-table methods. As a result, the sequence of work elements, the manner in which the work was performed, and the equipment employed underwent many changes before an acceptable boning procedure was established. Changes still can be made in the boning sequence for performing some of the jobs without adversely affecting the time requirements and quality of the product. However, through changes, more valuable meat cuts may be damaged or yield may be reduced if the cuts are not removed in the suggested sequence. For example, if the shoulder clod is removed before the rib roll, the boner's knife occasionally penetrates so deep as to cut the surface of the rib roll. Also, we found that to obtain a full size rib roll it was necessary first to remove the feather bones.

An air-powered beef scribe saw with about a 3/4-inch depth of cut was used to saw through the feather bones about 1 inch from and parallel to the spinal cord cavity in the backbone (fig. 1). A knife was then used to cut the feather bones off the back between the hip and neck bones (fig. 2).

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Figure 1.--Sawing feather bones with beef scribe saw.

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Figure 2.--A deep continuous cut between the feather bones and meat allows the feather bones to be removed in a single strip.

After the feather bones were removed, cuts were made through the rib roll at the 13th rib and between the third and fourth ribs. A vertical cut was then made between the backbone and rib roll and a hand hook was used to remove the rib roll (fig. 3).

The foreshank then was removed and boned on a regular boning table (fig. 4). The shoulder clod was separated from the blade bone by cutting between the blade bone and shoulder clod (fig. 5). The shoulder clod was then cut along the upper edge to free it from the adjoining meat on the chuck. Next, the foreshank end of the shoulder clod was grasped and pulled off the chuck (fig. 6). The blade bone was removed and vertical and horizontal cuts were made on the carcass side to mark the separation of the chuck from the remaining rib meat and full plate (fig. 7).

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Figure 3.--Removing the rib roll with a hand hook.

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Figure 4.--Cutting along the arm bone to free the foreshank meat.

The atlas bone was removed from the neck meat and deep cuts were made between each of the neck bones to disjoint them (fig. 8). The neck bones then were removed one at a time (fig. 9).

The kidney, excess fat, and hanging tenderloin were removed and a continuous cut was made along the upper side of the 13th rib to sever the forequarter and hindquarter meat. The inside skirt and plate meat was cut off the ribs (fig. 10). The point of the knife was used to cut along each side of the ribs to free the intercostal meat (fig. 11). A continuous cut was made along the rib ends and breastbone to separate the meat from the bones (fig. 12).

Next, the side was rotated 180° and circular cuts were made between the ribs to free the intercostal meat from the backbone (fig. 13). The remaining forequarter meat was removed from the bones by cutting the meat free from each rib bone starting at the 13th rib (fig. 14).

The flank was secured with a hand hook and a knife was used to cut the flank off the hindquarter (fig. 15). Next, a deep continuous cut was made between the round and rump along the upper edge of the rump bone. The side then was rotated 180° and a second cut was made to join the start and end of the first cut (fig. 16). Vertical cuts were made on both sides of the

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Figure 5.--At the shank end of the shoulder clod, a cut is made between the blade bone and shoulder clod.

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Figure 6.--Pulling the shoulder clod off the chuck.

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Figure 7.--A vertical cut is made through the meat to mark the separation of the chuck from the full plate.

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Figure 8.--Cutting between two neck bones.

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Figure 9.--Removing a neck bone.

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Figure 10.--Cutting the inside plate meat off the ribs.

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Figure 11.--Cutting on each side of the ribs to free the intercostal meat.

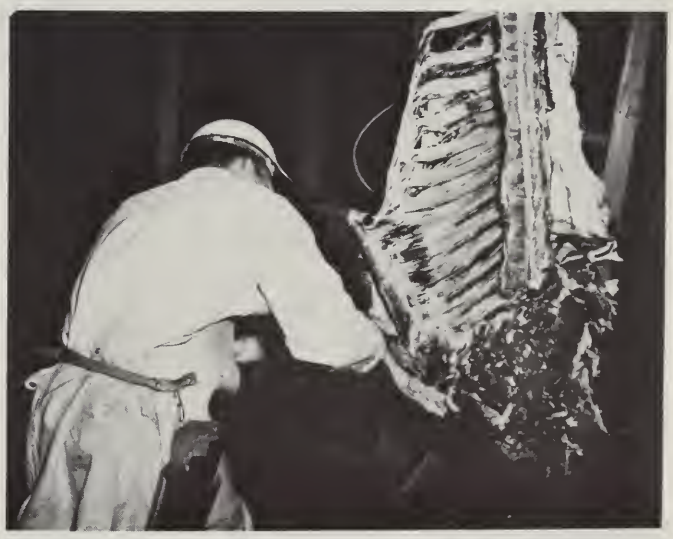

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Figure 12.--Cutting between the brisket meat and breastbone

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Figure 13.--A circular cut is made between two ribs to free the intercostal meat from the backbone.

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Figure 14.--Cutting along a rib bone to free the meat.

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Figure 15.--Removing the flank from the hindquarter.

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Figure 16.--Making the second cut between the round and rump.

tenderloin, and the butt end of the tenderloin was cut free from the hip bone. The butt end of the tenderloin was then hooked and pulled off the backbone (fig. 17). Next, a deep continuous cut was made along the lower edge of the hip bone to separate the strip loin meat from the sirloin butt (fig. 18). Cuts were made between the backbone and strip loin and on either side of the finger bones. A hand hook was used to pull down on the strip loin while a knife was used to free the meat still attached to the bones (fig. 19). Deep cuts were made from the kneecap to the rump bone on both sides of the round. The kneecap was removed from the knuckle and the knuckle was cut off the round (fig. 20).

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Figure 17.--Using a hand hook to pull the tenderloin.

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Figure 18.--Cutting between the strip loin and sirloin butt meat.

A rope loop was placed around the hock and over the trolley hook to prevent the side from falling when the hind shank tendon was cut and the inside and outside rounds and shank meat were removed from the bones (fig. 21). To remove the last large meat cut from the carcass bones, a cut was first made along the pelvic and tail bones and then the rump-butt meat was removed (fig. 22).

A mechanical bone trimming knife was used to remove the small pieces of meat still clinging to the carcass bones (figs. 23 and 24).

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Figure 19.--Separating the strip loin from the backbone.

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Figure 20.--Cutting the kneecap off the knuckle.

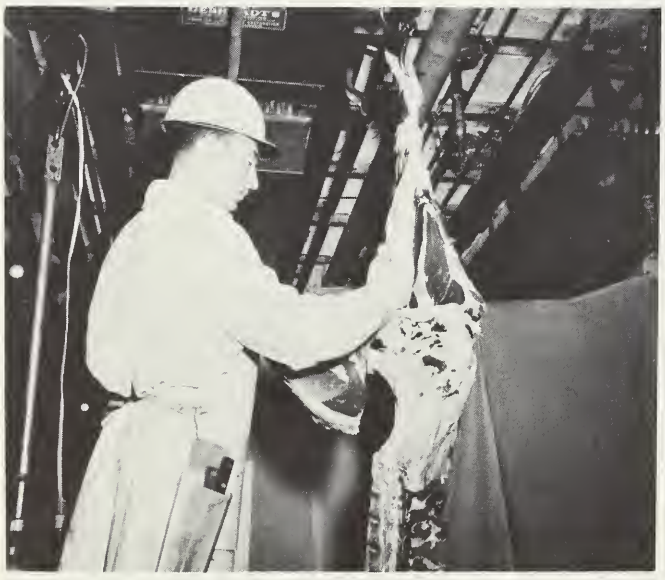

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Figure 21.--Removing the inside round.

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Figure 22.--Cutting between the pelvic bone and rump-butt meat.

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Figure 23.--Removing meat scraps from the backbone with a mechanical bone trimming knife.

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Figure 24.--Removing meat scraps from between rib bones with a mechanical bone trimming knife.

LABOR REQUIREMENTS

Detailed time studies were made of on-the-rail boning of 80 beef carcass sides to obtain productive labor requirements that could be used to develop possible job assignments for a synthetic on-the-rail boning line. Data on labor requirements for boning on the rail cannot be compared realistically with labor requirements for the conventional boning methods because: (1) Only one worker was used throughout the time studies; (2) no time was included for trimming the meat cuts; (3) all carcass sides were hung from an 11-foot high rail which causes the worker to assume an awkward position while boning the neck area; and (4) no allowance was made in the data for the movement of carcass sides between work stations and for idle time due to carcass weight variations and job regulated wait time.

The eight weight ranges selected for the time studies are shown in table 1. The carcass weight is the weight recorded on the slaughter floor carcass tag. Productive time is the amount of time required for a skilled worker to perform a time item or segment of an operation at a normal pace, plus an allowance of 15 percent of the time to compensate for sufficient rest and relaxation to permit him to maintain normal performance throughout the day and to allow for personal needs.

Table 1.--Labor requirements to bone beef carcass sides on the rail by weight range, number of sides, average weight, and section of carcass

Weight range	Carcass sides	Average carcass weight	Productive time			
			Bone forequarter	Bone hindquarter	Clean bones	Total
Pounds	Number	Pounds	Man-minutes	Man-minutes	Man-minutes	Man-minutes
250-299	3	273	12.72	4.53	4.03	21.28
300-349	5	337	13.15	4.49	4.70	22.34
350-399	10	376	12.65	4.44	4.69	21.78
400-449	21	428	12.97	4.72	5.02	22.71
450-499	17	474	13.88	4.89	5.40	24.17
500-549	14	526	13.85	5.01	5.26	24.12
550-599	9	578	13.99	5.15	5.75	24.89
600-649	1	626	13.79	5.49	5.59	24.87

Based on the experiments conducted on boning beef carcasses on the rail it appears that a skilled boner is required to bone the forequarter and hindquarter areas of each beef side; however, a semiskilled worker with a little practice can operate the mechanical bone trimmer satisfactorily to clean the carcass bones. Bone cleaning, which amounts to approximately 20 percent of the total boning labor, thus could be done by workers at a lower wage rate.

Figure 25 is a graphic presentation of the data shown in table 1. The lines that divide each segment of work on the graph show the linear increase in time required as the carcass weight increases.

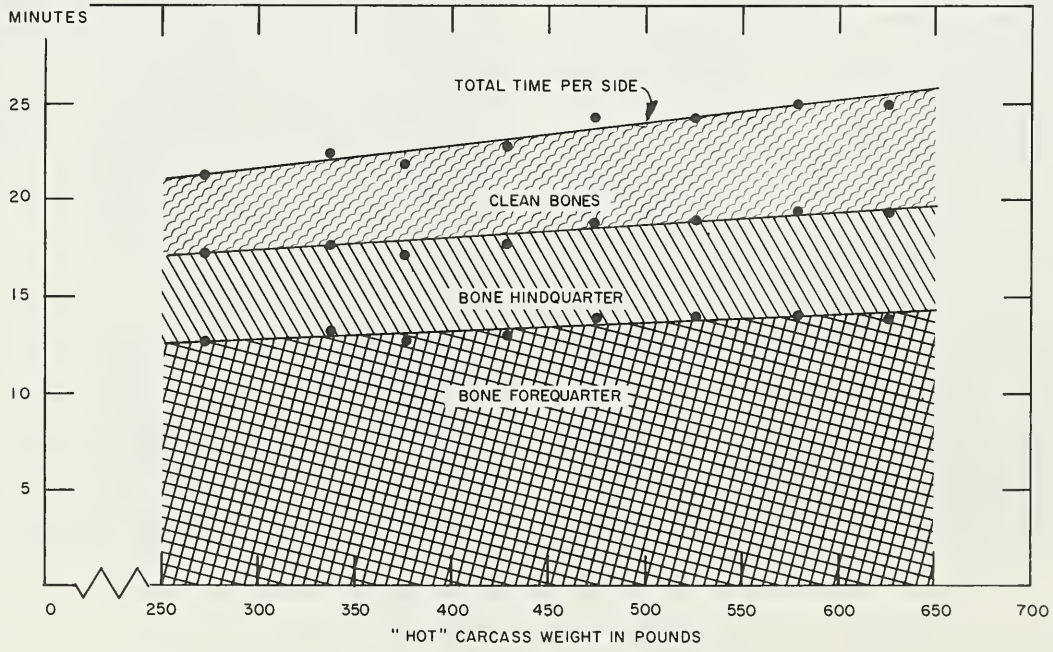


Figure 25.--Productive boning time per side for various carcass weights.

CARCASS YIELD TESTS

Fourteen yield tests were conducted to compare the weights of the various meat cuts of beef carcass sides that were boned on the rail with carcass cuts from sides that were boned on tables. A total of 52 carcasses was used with opposite sides boned on the rail or on tables. About the same number of right and left sides was boned by each method.

A mechanical bone trimming knife was used to clean meat scraps from carcass bones hanging on the rail. Those not cleaned were the foreshank, blade, and neck bones. For all sides boned on tables, a mechanical knife was used to clean only the strip loin bones.

With the exception of one test involving two of the carcass sides boned on tables by the regular boning crew, the worker used in the other tests (and a worker he trained) boned the carcass sides on the rail and the carcass cuts on tables. These two workers used the boning room breaking saw to separate sides into conventional cuts and then boned these cuts on tables located adjacent to the on-the-rail boning area. Emphasis was placed on accurately weighing the carcass sides just before boning and the meat cuts in each product group after boning. The bones, excess fat, kidneys, and unusable trimmings were not weighed.

Table 2 shows the total weight and average yield for the eight meat product cuts used in the yield tests. The on-the-rail method produced a slightly higher total percentage meat yield (75.26 percent) despite a lower yield for some of the more valuable meat cuts.

Eight tests not related to the 14 yield tests were made to determine the weight of meat trimmings removed with the mechanical knife from the carcass bones hanging on the rail. The amount of trimmings per side ranged from 5.31 to 7.37 pounds, an average of 6.57 pounds.

CARCASS MEASUREMENTS

To establish the general location of selected points on beef carcass sides for 10 weight groups, 175 chilled carcasses were measured and their kill floor weights recorded (see table 3). The location of the points measured on each carcass side is shown in figure 26. The variation between the shortest and longest carcass in each weight group averaged about 7 inches at the 13th rib and 12 inches at the lower edge of the neck. The horizontal distance from the centerline of the carcass side to the outer edge of the neck varied about 2 inches for each group while the variation from the centerline to the outer edge of the foreshank was about 4 inches.

The data on carcass dimensions were used to develop a typical work station platform for on-the-rail boning, fig. 27. A stainless steel kick plate is located along the front of the platform to prevent foreign material from falling onto meat cuts on the meat cut conveyor. Guard rails are located to the front and rear of all platforms along the meat conveyors. The guard rail in front of the worker should be slightly above the knees. The horizontal distance between the centerline of the overhead carcass rail and front edge of the work platforms should be at least 18 inches whenever the vertical distance between the platform and top of the overhead rail is less than 11 feet. To minimize contact between meat cuts on the conveyor belt and carcass sides on the rail, a distance of 12 inches between the lowest part of the carcass side and the conveyor belt is recommended.

Table 2.--Beef carcass yield comparison for boning 52 sides on the rail and 52 sides on tables 1/

Method and product	Total weight	Average yield 2/
	Pounds	Percent
On the rail		
Trimmings	3,047	27.10
Chuck	1,175	10.45
Clod	682	6.06
Round	1,811	16.10
Rump-butt	651	5.79
Shank	542	4.82
Tenderloin	192	1.70
Regular roll	365	3.24
Subtotal	8,465	75.26
Bones, etc. 3/	2,782	24.74
Total	11,247	100.00
On tables		
Trimmings	2,891	25.62
Chuck	1,169	10.36
Clod	690	6.11
Round	1,749	15.51
Rump-butt	804	7.13
Shank	565	5.01
Tenderloin	190	1.68
Regular roll	387	3.43
Subtotal	8,445	74.85
Bones, etc. 3/	2,837	25.15
Total	11,282	100.00

1/ Comparison based on boning the right side of a carcass by one method and the left side by the other. About the same number of right and left sides were boned by each method.

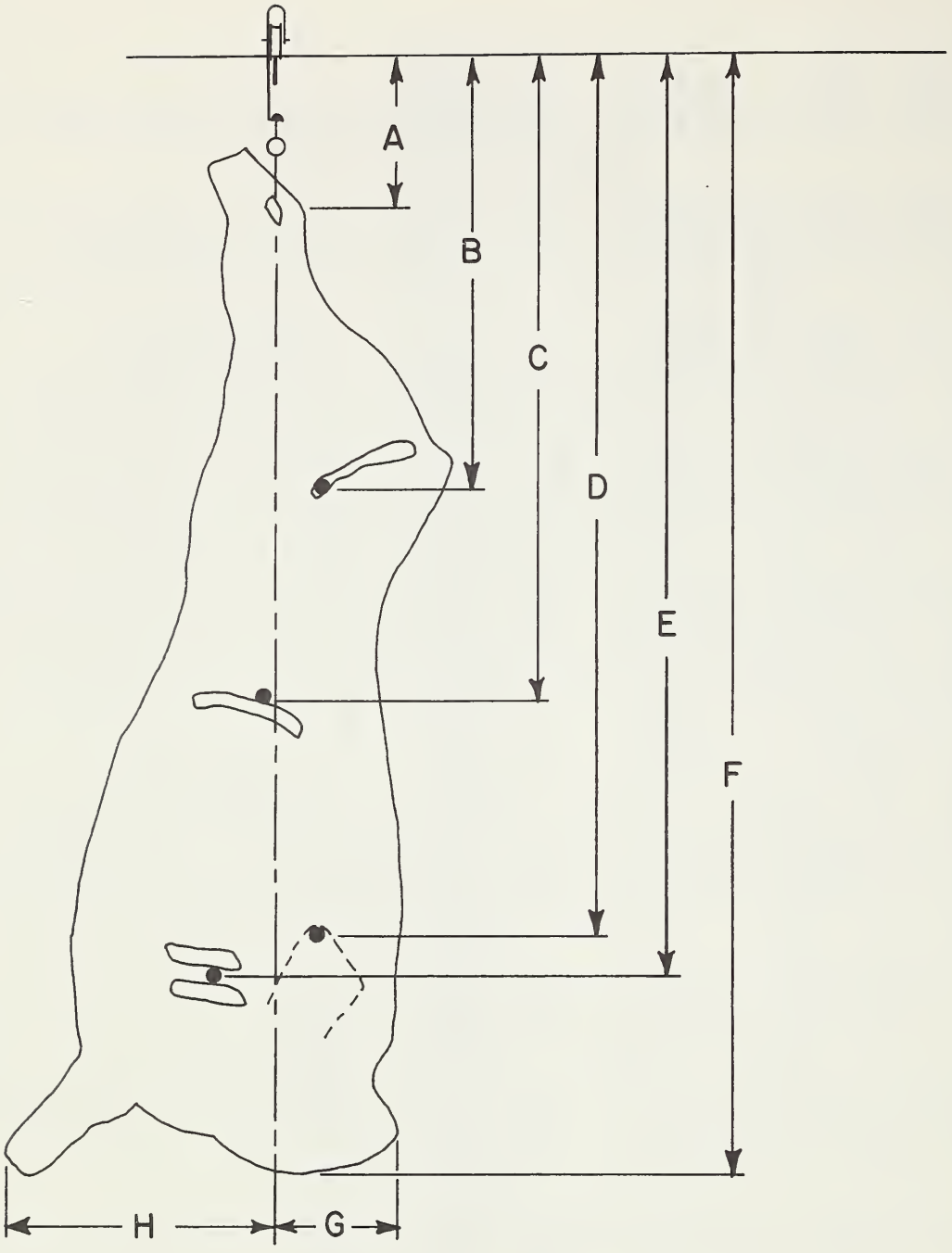
2/ Meat cuts were boned to George A. Hormel and Company specifications and the yields of some cuts are different from those found at other boning lines.

3/ Includes bones, excess fat, kidneys, and trimming losses. The weight was obtained by subtracting meat yield from carcass weight.

Table 3.--Beef carcass measurements by weight groups

Measurements 1/	Weight groups (pounds) 2/									
	250 to 299	300 to 349	350 to 399	400 to 449	450 to 499	500 to 549	550 to 599	600 to 649	650 to 699	700 and up
	Average inches	Average inches	Average inches	Average inches	Average inches	Average inches	Average inches	Average inches	Average inches	Average inches
Top of rail to:										
Bottom of trolley hook 3/----	14.25	14.45	14.67	14.63	14.56	14.63	14.45	14.43	14.38	14.80
Lower exposed edge of rump bone----------	35.75	36.27	36.09	37.06	37.34	37.52	38.64	38.55	39.40	40.70
Top center of 13th rib-------	55.75	56.27	58.25	59.12	59.41	59.19	60.14	61.27	61.30	63.80
Top edge of blade bone-------	73.25	74.91	77.33	77.50	77.78	78.88	79.55	79.57	82.13	86.20
Between 3rd and 4th rib------	81.50	82.27	83.81	85.61	85.86	86.52	87.93	89.82	91.20	94.60
Lower edge of neck----------	99.00	99.55	100.53	103.30	104.48	105.14	107.64	109.73	111.50	115.20
Center line of carcass to:										
Outer edge of neck----------	10.50	11.18	11.50	11.38	11.52	11.60	11.93	11.91	12.11	12.50
Outer edge of foreshank 4/---	20.00	21.72	22.06	23.16	22.17	22.70	24.07	24.36	25.33	25.88
Number of carcasses measured---	4	11	32	33	29	21	14	11	10	10
Average weight of carcasses----	282.50	326.27	374.06	423.61	474.31	524.76	567.64	622.91	674.10	783.80

1/ Graphically shown in figure 26.
2/ Carcass weights obtained from hot carcass tag. Only fully chilled carcasses were measured.
3/ Length of trolleys varied between 14 and 15 inches.
4/ Foreshank extends about 6 inches beyond brisket edge.



Top of rail to:
- A. Bottom of trolley hook
- B. Lower exposed edge of rump bone
- C. Top center of 13th rib
- D. Top edge of blade bone
- E. Between 3rd and 4th rib
- F. Lower edge of neck

Center line of carcass to:
- G. Outer edge of neck
- H. Outer edge of foreshank

Figure 26.--Location of measurements made on beef carcass sides.

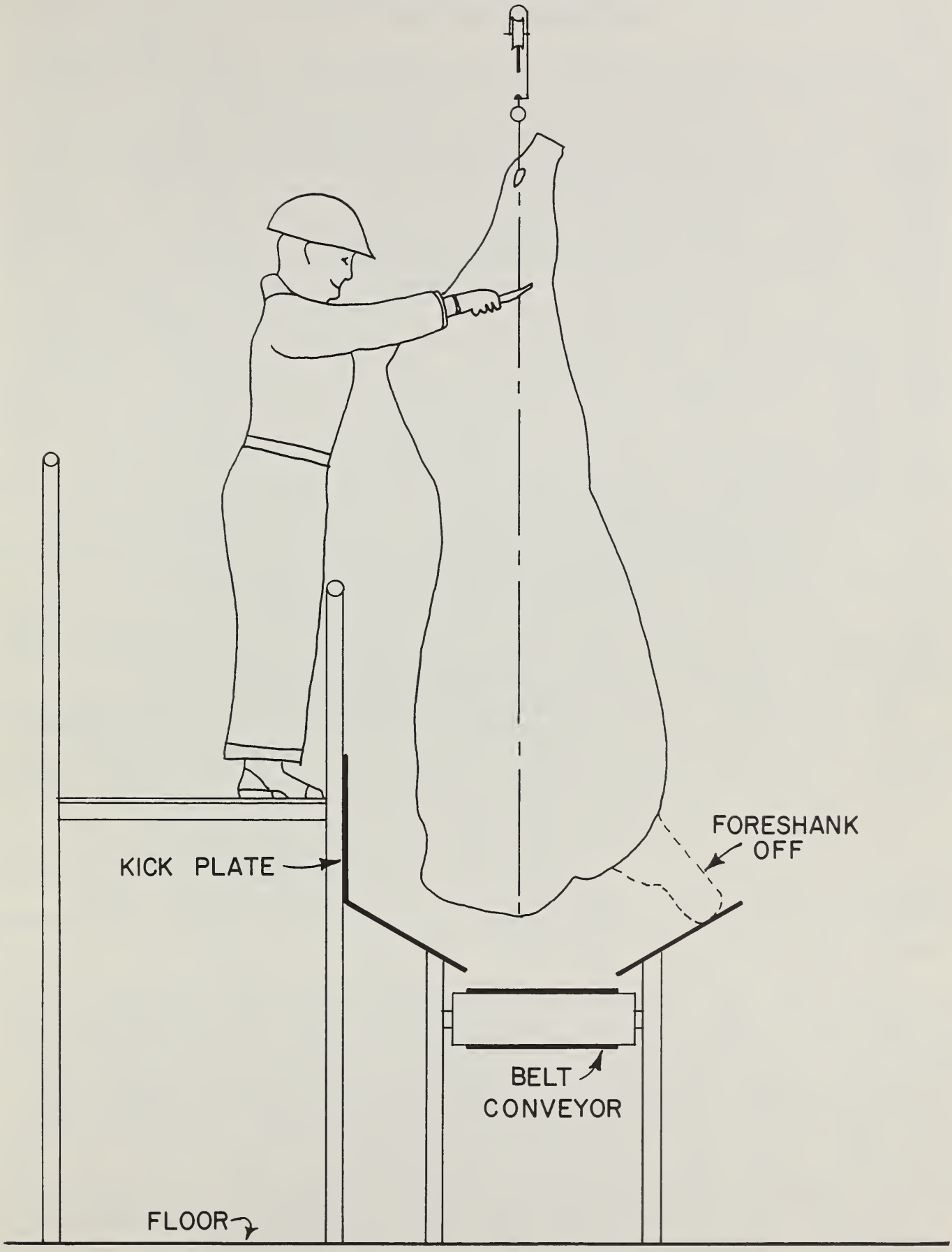


Figure 27.--A suggested work station for boning on the rail.

LAYOUT FOR ON-THE-RAIL BONING

A tentative layout for an on-the-rail boning line was developed after a boning procedure was established, the boning worker had acquired the skill needed to allow preliminary time studies, and a significant number of carcasses was measured. As the research progressed, additional layouts incorporating changes in equipment and work stations were developed for handling different volumes. The final layout is a gravity rail-type to handle between 13 and 14 carcasses an hour weighing an average of 450 pounds (fig. 28). The overhead carcass rail is installed in an L-shaped configuration. However, it could be straight or U-shaped if the space available required a different design. The layout shows 11 work stations. If the line is to be operated at a rate less than the 13 to 14 carcasses per hour, such as during the off season, several work stations can be eliminated and the work shifted to the remaining stations without a significant loss of efficiency. The height of some work platforms might have to be changed to accommodate the new job assignments. For the line to handle more than 100 carcasses daily, it would be difficult to add additional work stations. To raise this level above about 100 carcasses daily, the line can either be operated in excess of 8 hours daily or the workers placed on a wage incentive plan. In either case, 11 line workers in an average plant probably could not maintain a production rate more than 30 percent above normal.

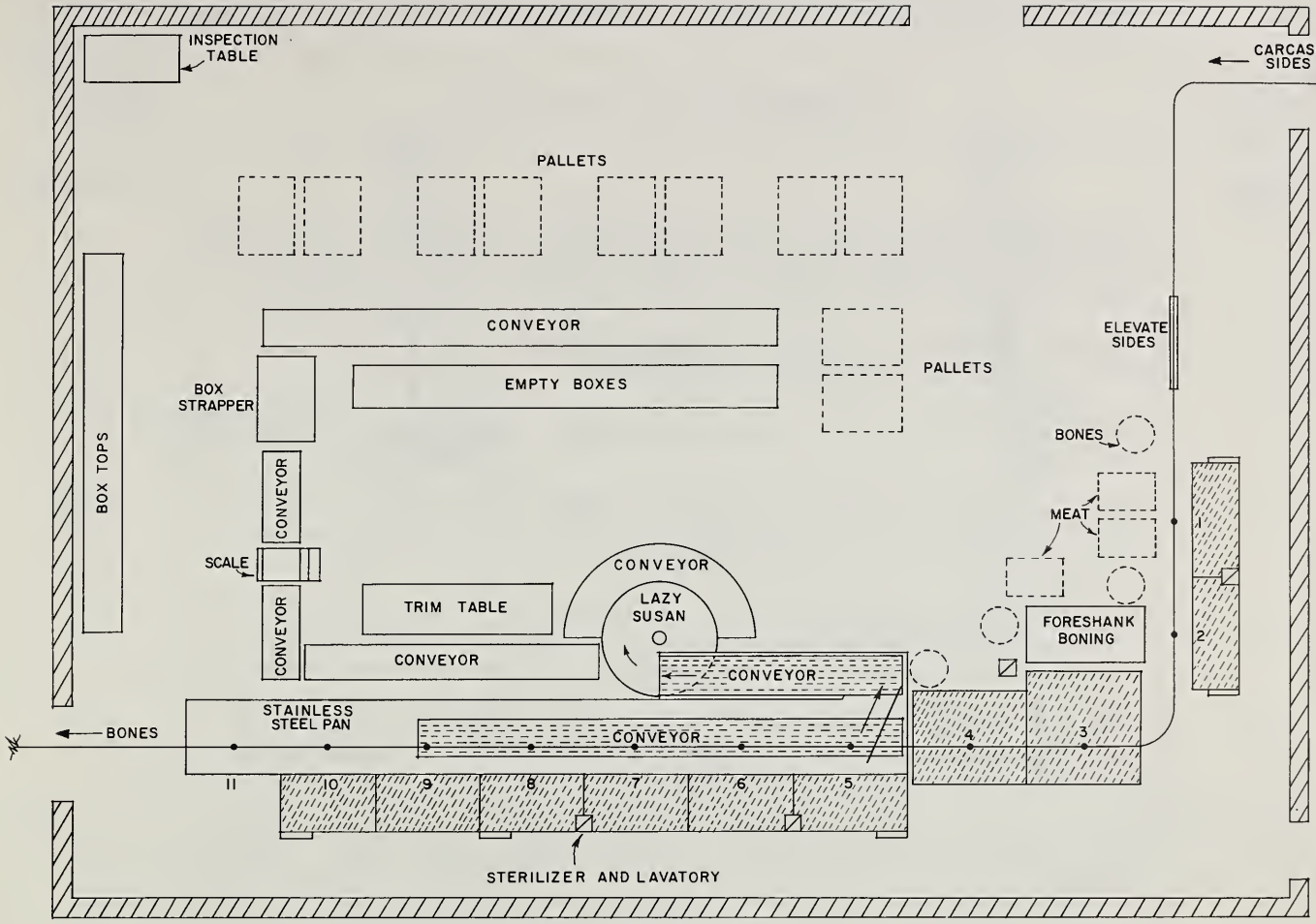
Table 4 shows the suggested job assignments and the productive time for each of the work stations shown on figure 28. The job assignments are based on the boning procedure, if applicable, and the carcass measurements shown in table 3. At each work station almost all of the assigned work for carcasses that weigh between 250 and 700 pounds can be performed between 42 and 75 inches above the area where the worker stands. This vertical range of 33 inches was assumed to be the most productive work area for a standing worker.

To limit contact between carcass sides, provide adequate space for performing the assigned jobs, and protect workers from accidental injury by adjacent line workers, the following horizontal distances are recommended between work stations: (1) 6 feet between stations 1 and 5; (2) 5 1/2 feet between stations 5 and 9; and (3) 5 feet between stations 9 and 11.

A loop made from a 38-inch-long nylon rope (500 pound test) was used to prevent the carcass side from falling when the hind shank tendon was cut, figure 29. A disadvantage in using this type holding device was that when the tendon was cut the rope allowed the side to drop about 12 inches. This increased the distance required between the overhead rail and the boneless meat conveyor under the carcass side.

A gravity rail with a 3/8-inch per foot slope was selected for the boning line after tests were conducted on two overhead cooler rails installed to slope 1/4 inch and 3/8 inch per foot. With a 3/8-inch slope, the trolley wheel was less likely to roll up the slope away from the rail stop as the worker turned and pulled on the carcass side while boning it. A powered trolley incline conveyor is suggested for raising carcass sides from the 11-foot-high cooler rail level to the "on" end of the gravity rail at 14 feet 8 5/8 inches above the floor. A rail stop is located at each work station, and between the "on" end of the gravity rail and the first work station.

The height of all work platforms is shown on figure 28. Work platforms for stations 1 and 2 are only 30 inches wide since ladders are provided for each boner to ascend to the work station without passing behind the other worker. Since line workers have to pass behind others to reach stations 6, 7, and 9, the work platforms for stations 5 through 10 are 36 inches wide.



WORK STATION NUMBER	PLATFORM HEIGHT INCHES	RAIL HEIGHT FEET
1	42	14.50
2	28	14.31
3	6	14.03
4	9	13.85
5	36	13.66
6	30	13.48
7	60	13.30
8	66	13.11
9	60	12.92
10	36	12.74
11	--	12.66

Figure 28.--Suggested layout for an on-the-rail line for boning about 100 beef carcasses daily.

Two powered belt conveyors 24 inches wide move meat cuts to the "lazy susan" at the packaging area. The longer conveyor serves work stations 5 through 9 and handles most of the meat removed from the side. This conveyor could be extended to work stations 10 and 11. However, due to the relatively small amount of trimmings removed, a stainless steel pan about 48 inches wide should be adequate. The trimmings removed at stations 10 and 11 then can be pushed up to the conveyor from time to time for transport to packing. Work stations 1 through 4 are not located on a meat conveyor, since the rib roll, shoulder clod, and foreshank meat removed at these stations usually are handled and packed separately. A deflector transfers the boned meat from the off end of the longer conveyor to the second conveyor for transport to the lazy susan. Three meat containers on wheels should be placed at the locations shown on the layout to receive the boned meat removed at these four stations.

Table 4.--Suggested job assignments for an 11 work station line for the on-the-rail boning of about 100 beef carcasses daily 1/ (average carcass weight 450 pounds)

Work station identification	Job assignments per carcass side	Productive time per side 2/
Number		Man-minutes
1	Use powered scribe saw to saw through feather bones from hip to neck. Remove feather bones from side. Cut through rib roll at either end and pull back strap. Remove rib roll. Start to remove foreshank.	2.17
2	Complete removal of foreshank. Remove shoulder clod. Remove blade bone. Clean meat scraps off blade bone.	2.17
3	Bone foreshank on table. Remove atlas bone. Start to cut between neck bones.	2.19
4	Complete cutting between neck bones. Remove neck bones. Cut along breast bone and ribs to separate meat. Start to scribe along each side of ribs to loosen intercostal meat.	2.18
5	Remove hanging tenderloin and cut through flank. Remove inside skirt and plate meat. Complete scribing along each rib. Start to cut from outside between ribs to separate intercostal meat from backbone.	2.19
6	Complete cutting from outside between ribs to separate intercostal meat from backbone. Make vertical and horizontal cuts to mark chuck, rib, and full plate. Remove remaining meat from forequarter bones.	2.18
7	Remove flank. Cut between round and rump bone. Remove tenderloin. Cut between sirloin butt and strip loin. Remove strip loin. Start to remove knuckle.	2.15
8	Complete removal of knuckle. Get rope and place around hock and trolley hook. Cut hind shank tendon. Remove top or bottom round. Remove bottom or top round. Remove rump-butt.	2.15
9	Remove shank meat. Start to clean hindquarter bones with mechanical knife.	2.19
10	Complete cleaning hindquarter bones with mechanical knife. Start to clean forequarter bones with mechanical knife.	2.19
11	Complete cleaning forequarter bones with mechanical knife.	3/ 1.14

1/ Eleven work stations manned by eight skilled boners, and three semiskilled mechanical bone trimming knife operators.

2/ Does not include time for the movement of carcass sides between work stations and delays due to carcass weight differences, carcass condition (amount of bruise trim), and other job regulating factors.

3/ Worker has 1.05 minutes per side job regulated wait time. He can perform other jobs when idle, such as dispose of bones, get boxes, strap boxes, and weigh meat.

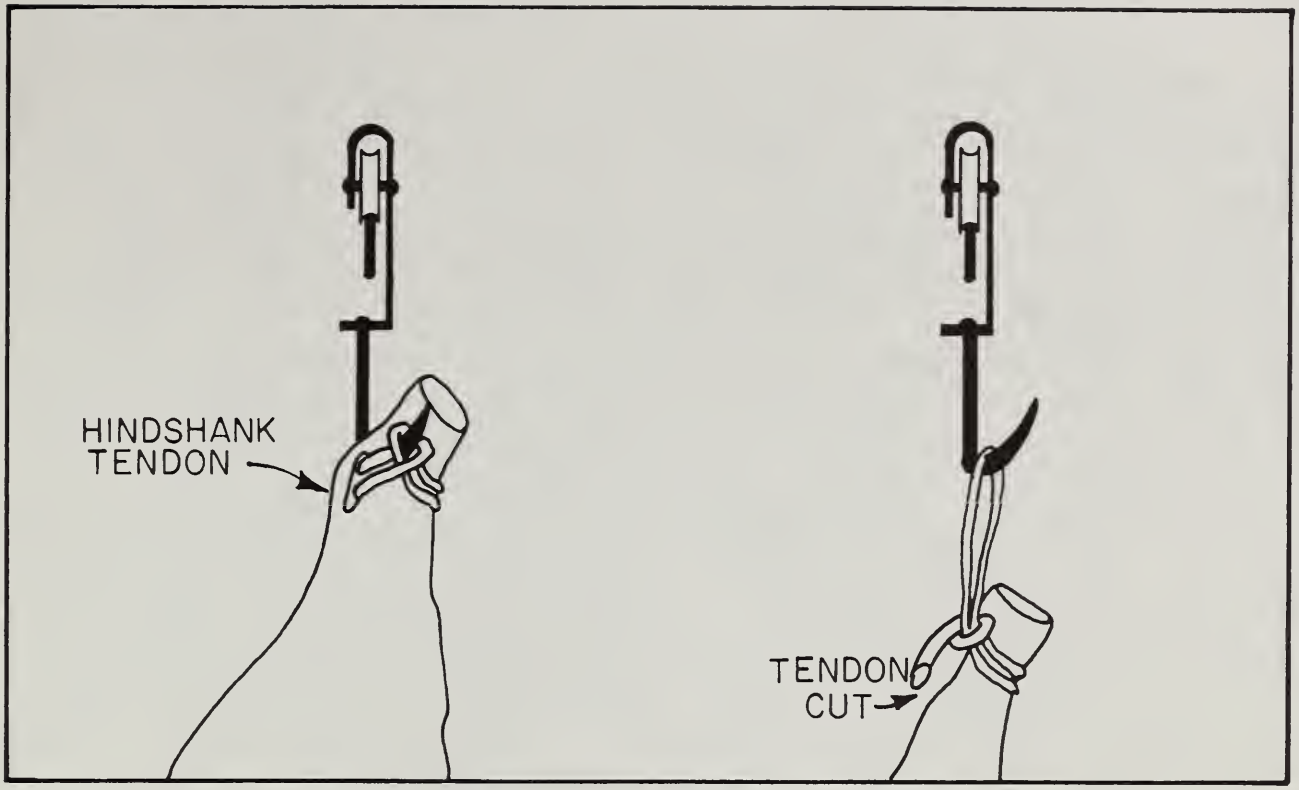


Figure 29.--A rope is used to prevent the carcass side from falling when the tendon is cut. The rope loop is placed around the hock and over the trolley hook. When the hindshank tendon is cut the slack in the loop allows the carcass side to drop about 12 inches.

Four combination knife sterilizers and lavatories are recommended for cleaning tools and for washing hands whenever abscesses or other infections are removed from the meat during the boning work. Work stations 9 through 11 are bone trimming locations and do not require sterilizer-lavatories.

To provide adequate lighting for the boning, packaging, and inspecting, at least 50 foot-candles of light should be provided in these areas.

The boned meat packing area is arranged for weighing packed boxes. The pallets shown in figure 28 hold packed boxes of 10 different meats. The aisle between the wall and pallets is 8 feet wide to permit the use of powered lift trucks for transporting loaded pallets to shipping or storage areas.

The few carcass bones removed at work stations 1 through 4 are handled in barrels or similar containers. The carcass bones, still hanging on the rail after the meat trimmings are removed, are transported in groups on the overhead rail to a rendering truck or holding container. The nylon cord (see figure 29) is cut and the bones dropped when each trolley is over the truck or container.

The layout provides guidelines and information resulting from boning on-the-rail research. Construction and related details needed to comply with Federal meat inspection requirements are not included. Since the inspection and sanitation requirements for construction of meat boning facilities are rigid, it is recommended that plans be submitted to the Federal or State meat inspection authorities for approval before beginning construction.

CONCLUSIONS

Beef carcass sides can be successfully boned while suspended from trolleys hung on an overhead rail. The results of detailed time studies of the boning of 80 carcass sides show that carcasses weighing an average of 450 pounds can be boned at a rate of about 1.3 per man-hour. The procedure developed permits the use of semiskilled workers to clean meat scraps off the carcass bones with mechanical bone trimming knives. About 20 percent of the total boning time per carcass can be handled by these workers and at a lower wage rate than that paid to skilled boners.

Yield tests were favorable to the on-the-rail method. Fifty-two carcasses were used in tests to compare the weight and quality of meat cuts when opposite sides were boned on the rail and on tables. While the yield percentage of some of the more valuable meat cuts was lower when boned to Hormel's specifications on the rail, the total meat obtained was greater. For example, an on-the-rail line that produces boneless beef rather than specific boneless cuts and averages boning 100 head daily at about 450 pounds each would, in a 260 work day year, produce about 49,000 pounds more meat than would be produced using the table method. The annual value of this additional meat, based on May 1971 prices of $63.00 per hundredweight for 90 percent lean boneless beef, would be about $30,900. The extensive use of mechanical bone trimming knives is primarily responsible for this increase in yield.

The authors believe that a boning on-the-rail system is feasible for boneless beef operations where most of the meat produced is used for sausage manufacture. The major advantages of this system are: (1) More flexible as to line arrangement (L-shaped, straight, or U-shaped) which should require about the same floor space as a conveyor boning line for equal production; (2) more sanitary since the meat is handled less and the bone smear from the breaking saw is eliminated; and (3) less fatiguing to workers boning chuck, loin, and round since these heavy meat cuts are not handled manually.

Some of the major disadvantages of an on-the-rail boning line are: (1) At least a 16-foot ceiling height is required in the boning room to provide adequate clearance between the bottom of the carcass sides and the meat boning equipment and floor when handling about 100 carcasses daily; (2) carcass sides are more difficult to bone at some work stations if the vertical distance is less than 96 inches or more than 120 inches from the lowest part of the neck to top of the rail; (3) when carcass sides of widely varying weights are boned or large areas on sides have been removed due to bruises there can be a considerable amount of job regulated wait time for the line workers; and (4) bone-in pieces such as strip loins cannot be removed from the carcass sides.